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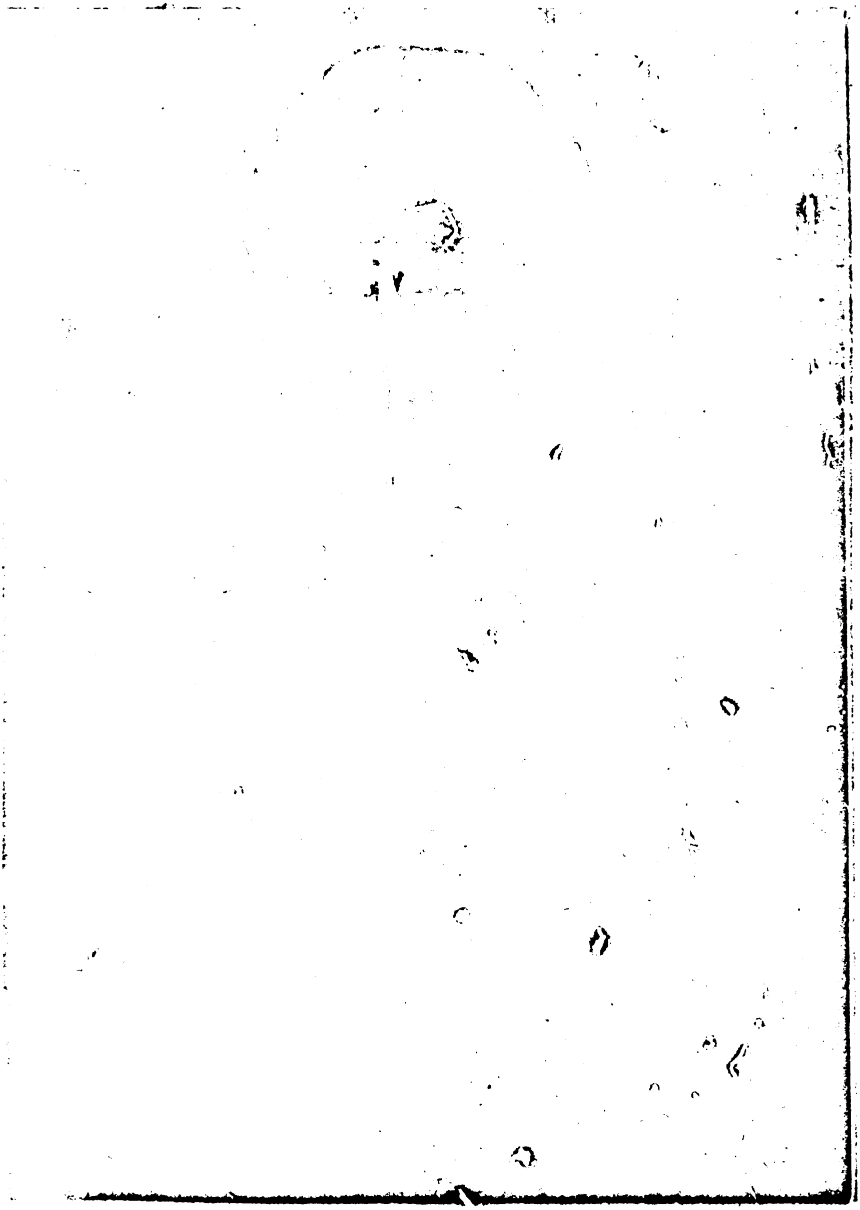

WILHELM CONRAD ROENTGEN

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Presented to the members of the Radiological Society of North America on the occasion of the Fifteenth Annual Meeting of the Society held in Toronto, Canada, December 2-6, 1929. With the compliments of the Local Committee.

Acknowledgment

¶ *Information concerning the life of Roentgen was gleaned from many medical and other publications and from original sources. In particular the author is indebted to articles by I. Seth Hirsch, of New York, and Prof. A. Sommerfeld M.D., of the University of Munich.*

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INTRODUCTION

IN considering various ways by which the memory of this meeting of the Society in Toronto might be preserved, the suggestion was made that a brief sketch of the life of Roentgen in book form, better than any other means, would serve the purpose. ❦ ❦ ❦

¶ *Mr. Percy Ghent, who undertook the work at my request, is the senior technician in the Radiological Department, Toronto General Hospital, a member of the Canadian Authors Association, and I am happy to be able to say after many years as his chief, still my friend. The volume is intended to be, as its title indicates, merely a brief biographical sketch, and not in any sense a formal "life" of Roentgen.* ❦ ❦ ❦ ❦ ❦ ❦

¶ *While the main facts of Roentgen's life are probably well known to the average radiologist through articles appearing in the various periodicals, this small volume, as far as can be ascertained, marks the first appearance of a biographical sketch in book form. And the human side of the story is so delightful and inspiring that the production of the sketch in this concise and handy way, was thought desirable. The genius who made possible not only the work in which we are engaged, but indeed the meeting in honour of which this sketch has been prepared, must always be, in the words of the closing paragraph, "a challenge and an inspiration."*

❦

G. E. Richards
Director, Department of Radiology
Toronto General Hospital

ROENTGEN

A BRIEF BIOGRAPHY

HISTORICAL

ABOUT the middle of the eighteenth century, the Abbe Jean Antoine Nollet, French physicist of peasant birth, exhibited before the amused eyes of the dilettanti savants of his day, certain phases of electrical phenomena, the result of many hours of intensive study in his quaint laboratory. They beheld, for instance, a curious, ovoid contrivance of glass, which Nollet called, not inappropriately, the "electric egg". It had been rarefied, more or less, by means of the air-pump devised in 1650 by Otto von Guericke, versatile mayor of Magdeburg, and, energized by a static machine, a spark was made to leap across this egg-like device with a crackling—or should we say cackling?—sound. Crude and primitive as this glass bulb of Nollet's undoubtedly was, it represented, perhaps, the earliest and humblest ancestor of the modern vacuum tube of marvellous performance, and as such, commands respect. Following the experiments of the French physicist, nearly a century elapsed in this field of scientific research without recorded progress of great significance.

Then came the momentous work of one of the greatest of modern scientists—Michael Faraday, one-time messenger boy and book-binder's apprentice. His interest in books seems to have penetrated more deeply than the binding, for when, in the course of business, a few scientific works fell into his hands, he read them with such avidity and profit that he forthwith dedicated his life to the study of electricity. To the patient study and endless experiments of this modest Englishman, we are indebted very largely, for the production of electrical power as we now have it, for it was his discovery of the phenomenon of electro-magnetic induction that made this development possible.

Brilliant research was carried out by Faraday in 1837 and later, on the luminous effects created in various gases by electric discharges, noting the rich and varied colors of the discharge in nitrogen, and the modified tints in hydrogen and oxygen, changing with degrees of atmospheric rarefaction. His work marked the true beginning of the long series of investigations that ultimately brought about the discovery of the x-ray, and the way to further exploration which he pointed out, was soon to be followed by others. Abria did some interesting work with induced voltaic current in rarefied gases in 1842, and an important forward step was made some years later by Plucker, for whom Geissler had produced the first tube in which a vacuum, although a low one, could be indefinitely maintained. Electrodes of platinum wire were fused into the walls of the Geissler tube, which Plucker then excited with electric current, creating attractive luminous colors and striae at the cathode end.

In 1869 Hittorf made important researches which led to the discovery of hitherto unsuspected rays which appeared to originate at the negative pole. Scant attention was paid to them, however, until the absorbing experiments of Crookes in 1879, when the cathode stream was described in a brilliant, masterly way, rarely excelled. His prophetic words concerning this phenomenon, unlike any other solid, liquid, or gaseous manifestation, but rather a "fourth estate of matter", only serve to stress that almost tragic episode of experimental science, when a strange caprice of fortune permitted this master-physicist to produce x-rays, as he undoubtedly did, and yet not actually discover them. Hertz, in 1892, conducted experiments which led him to the conclusion that the cathode stream could pass through the glass walls of the tube and suggested further investigation outside the vacuum. After the death of Hertz, his pupil, Lenard, entered this phase of exploration with keen engagement, coaxing the cathode stream out of the tube by means of an aluminum window, and noted its effects, including the fogging of photographic emulsion, with surpassing care. Lenard's work was the final step of a long journey in science, before the actual discovery of the x-ray. Von Guericke, Nollet, Faraday, Plucker, Geissler, Gassiot, Hittorf, Morgan, Crookes, Thomson, Hertz, Lenard, and many other patient trail-blazers of science, share in the glory of this profound achievement. But to Roentgen belongs the supreme honor of having first recognized the existence of that new, unseen, and mysterious radiation, the discovery of which had been made possible by the labors of his predecessors, who builded better than they knew.

A solitary worker in his simple laboratory in Wurzburg, on that historic Friday the eighth day of November 1895, his Crookes tube hidden beneath a light-proof shield of black cardboard and excited by a Ruhmkorff coil, he had observed, in the darkened room, the weird glow on that momentous scrap of paper coated with barium platino-cyanide, and made those investigations which gave to mankind in that dramatic moment, a new degree of vision. And with a restraint almost super-human, he devoted nearly two months to the intensive investigation of his great revelation before announcing it to the world.

A number of versions of the story of Roentgen's discovery have appeared, and several writers have strongly emphasized the part which accident and chance played in it. But was it accident? Here was a man, long interested in this phase of physics, deliberately covering his Crookes tube, thereby hiding from view all the then known phenomena of the excited vacuum tube, and obviously prepared for a new manifestation, if such could be evoked. So well prepared, indeed, that when the great secret was wrested from Nature, the spectacular revelation did not drive him into any hasty, fantastic speculations, but with cold-blooded, calm persistence, he pursued and elaborated his discovery with a thoroughness and accuracy attested by his first epoch-making pronouncement.

ROENTGEN

And supposing chance did come to his aid? Said Hugo Munsterberg of Harvard:

> "There were many galvanic effects before Galvani saw, by chance, the contraction of a frog's leg on an iron gate. The world is always full of such chances, and only the Galvanis and Roentgens are few."

In one strikingly apt and arresting sentence, the writer of an editorial appearing in the *Journal of Roentgenology*, shortly after the discoverer's death, thus sums up Roentgen's title to the gratitude and admiration of his fellow-men:

> "The flash of the fluorescent cardboard had to be answered by a flash of genius, and the rest was merely a matter of detail."

Roentgen, to his eternal honor, supplied that divine spark—and it set the scientific world on fire.

BIOGRAPHICAL

1845 — 1895

AMONG the stately hills of the lower Rhine, eighteen miles or so east of the busy industrial centre of Dusseldorf, lies the little town of Lennep, its citizens engaged mainly in the manufacture of woollens, cotton, and steel. Here on the 27th of March, 1845, was born Wilhelm Conrad Roentgen. His father, Frederich Conrad, was a Prussian farmer in moderate circumstances; his mother a native of Utrecht, Holland. Both parents seem to have been well blessed with those sterling, simple virtues of patience, industry, love of truth and modesty, which their only child inherited. Modesty, indeed, was so deeply ingrained in Roentgen's sincere nature, that even after his astonishing discovery had focussed the attention of the world upon him, he still found it difficult to understand why that world should be interested, in what to him, seemed the non-essential matters of his personal history, or his sympathies outside the sphere of his life work. Because of this quality of self-effacement, little seems to have been known, or at all events, written, about his early life. Certainly from the meagre details of his boyhood thus far available, it would be difficult to glean anything to show wherein the child was father to the man. There is no record of precocity such as stamped Wolfe as a soldier, even in his tender years; no boyish resolve to become a leader in science as Pitt had resolved to scale the heights of statesmanship; none of the intense, early application to study of a Faraday; no brave, youthful words about hitching his wagon to a star.

Many extraordinary men, after all, have been very ordinary boys, and Roentgen appears to have been just a normal, care-free lad, growing up, however, amid home influences of old-fashioned piety, thrift, and regularity, which have often proved so firm a foundation whereon to build a great career. No serious liberties would be taken with the truth were it assumed that Roentgen's life-long habit of reading the Bible was inspired by parental example.

His early boyhood was spent in Utrecht, that ancient city of Holland on the still more ancient Rhine ; and its quaint canals, stone bridges, imposing Gothic cathedral, and handsome public buildings must have furnished his young mind with many cherished memories. Here he received his primary education. Destined at first to become like his father a tiller of the soil, he was sent with that intent to the agricultural school at Apeldoorn, one of the most charming little towns of Holland, approached by majestic avenues of century-old elms ; famed for its flower gardens, and near to Castle Loo, delightful country seat of the Dutch royal family. Ample opportunity was found here to indulge that keen, inbred love of nature that was to bring him many hours of solace and recreation in later life, and, a sturdy youth, he entered with zest into the games and sports of his fellow-students. Life and study were not taken too seriously ; hours of idle dreaming were not deemed ill-spent, and the days sped by happily enough. Happy days indeed, but Fate, waiting around the corner in the guise of a so-called trivial incident, brought them to an abrupt conclusion. Trivial ! A soul-stirring volume could be written on the Might of Triviality. Newton sees an apple fall and interprets the law of gravity. Bunyan, on the trivial rebuke of a shrew for his profanity, is stung to reformation, dreams his Dream, and gives to the world a book which places him among the immortals. Roentgen, accused of participation in some mad student prank, pleads guilty, but with high ideals of schoolboy honor, stolidly declines to divulge to the Apeldoorn pedagogue in that mild inquisition, the identity of his fellow-conspirators. Loyalty to school friends brought the penalty of dismissal, and he was forced by trivial circumstance or kindly Providence, if you will, into a new path of knowledge, a changed direction of thought and ambition, that led, through time, to the discovery of the x-ray. And, losing a farmer, the world gained a genius.

This somewhat precipitous exit from Apeldoorn, and the failure to pass an examination, seemingly blocked the way to further advance in his academic course, for he lacked the credentials of matriculation. But it was revealed in some happy moment, that the Polytechnical Institute at Zurich was open to students of promise without this test. Thrice blessed be the men who made the portals of that shrine of Wisdom so wide and inviting. Entering this famed Swiss school, he glimpsed for the first time, perhaps, those towering heights of exploratory physics wherein he was destined to make so notable a conquest. Not that he made any fevered start with all-absorbing energy toward that goal. Even the spell wrought upon him by Clausius, famed expounder of the science, was rivalled by the perennial lure of the snow-capped peaks of the nearby Engadine, and he oft forsook the laboratory and the lecture hall for the quest of Alpine flowers, or the soul-satisfying adoration of the mountains. Throughout his long career Roentgen loved these cloud-crowned peaks, journeyed to them frequently; dreamed of them to the last lonely moments of his life. It would be easy to imagine one of his favorite biblical texts to have been :

"I will lift up mine eyes unto the hills,
from whence cometh my help"

for, most assuredly, his love of the mountains frequently brought relief in perplexity; balm for the irritating, petty cares of existence; renewed energy for grappling with the problems of the physical laboratory.

Clausius, propounding many original theories in the physics of heat, gases, and molecular phenomena, exerted a fruitful influence on the receptive mind of young Roentgen. Development of even greater significance resulted from his association with Kundt, who seems to have taken an unusual interest in this shy, reticent pupil, in whom he must have seen some promise of future greatness. To this teacher and friend, Roentgen owed much of his thoroughness and accuracy in practical research, and readily acknowledged the debt. Thus at the feet of these outstanding masters, and a voluntary, assiduous student in the School of Experimental Physics, he made striking progress which did much to compensate for the defects attributable to the interrupted training of his earlier schooldays.

In 1869, at the age of twenty-four, he was graduated from Zurich as Doctor of Philosophy, a degree earned by work assigned to him by Kundt. Called to Wurzburg, this same faithful friend took the future discoverer with him. But, learning of Roentgen's failure to conform with the regular routine of academical progress in previous years, there was considerable wrinkling of the lofty, intellectual foreheads, some elevation of the eyebrows, and polite regrets expressed that no place on the staff seemed to be available at the moment. They could not foresee the day, of course, when the work of this obscure, unimportant young man would bring a glory to their ancient institution, brighter, more lasting, than any created in all the hoary centuries of its previous existence. Determined however to work in association with his young protege, Kundt shortly afterwards transferred to the recently founded University of Strassburg, where social and academic barriers were neither so high nor so strict as at Wurzburg, and Roentgen, who had met the woman who became his wife at the latter city, settled down to an appointment at Strassburg, becoming, in 1872, privat-dozent in physics.

There would appear to be no equivalent of the German privat-dozent in the university life of any other country. It is a unique, Teutonic idea, and an institution held by many to be responsible in some degree for the high intellectual standing attained by the average German graduate. Untrammeled by any strict schedule of teaching routine, either of subject or the manner of its expounding, the privat-dozent is the free rival of the professors in whose realms he lectures ; a sort of academic free-lance, thrusting deeply where his seniors have touched but lightly; specializing in fields wherein the students feel they are weak. He is often brilliant, and usually popular with the pupils to whom he can be of so great service. With no particular love for the humdrum of standardized routine, it is more than likely that Roentgen enjoyed his dozentship intensely, and he must have created an excellent impression, for thereafter his way was smooth and progress consistent.

Appointed at the age of thirty to the professorship of mathematics and physics in the Academy at Hohenheim, he resigned in but a few months to return, at Kundt's request, to Strassburg, as associate professor of theoretical physics. This appointment he held for three years. What were the thoughts of the quiet young teacher as he strolled about the quaint streets of the ancient city of Strassburg, capital of that beloved province of Alsace, wrested from France but three or four years before by the might of Bismarck's armies? As a loyal German no doubt he was proud of this new and wealthy acquisition of the Fatherland, but the bitterness of the first years of annexation must have inspired some long and sober thoughts.

At thirty-four he is full professor of experimental physics at the thriving University of Giessen, a serene little town of Hesse, forty miles north of Frankfort-on-the-Main. He found the atmosphere of this university town friendly and congenial, was a welcomed visitor in many homes, worked happily in the well-equipped laboratories, and, after nearly a decade of the pleasantest kind of university life, left, with regret, for a similar position in the larger sphere of Wurzburg. With the passing of the years a change of heart and opinion has occurred in Wurzburg, for now he is deemed worthy to succeed the brilliant Kohlrausch. This was in 1888. Here, seven years later, occurred the phenomenal discovery that made Roentgen famous.

DISCOVERY

A NEAT and thriving town of more than fifty-thousand souls, nestling beside the Main, Wurzburg, in this age, is one of the chief industrial and educational centres of Bavaria. Relics of its ecclesiastical importance in the Middle Ages remain in the shape of a notable Romanesque cathedral, erected in the 10th century; a long stone bridge adorned with statues of the saints which spans the river; and many buildings of quaint, mediaeval architecture. Elaborate fortifications that once defended the ancient town, have given place to handsome promenades, but the famed old fortress of Marienberg still frowns from its commanding height. On the slopes of nearby hills flourish vineyards which produce famous wines, while other industries, less ancient and picturesque, thrive within the town. Its university, of Roman Catholic adherence, was founded originally in 1403. Save for these things, and perhaps for the unusual excellence of its local beer, Wurzburg, for centuries, made no salient claim upon the attention of the world until late in the year of grace, 1895.

It was early November, and along the tree-lined streets, strolled stolid Bavarian students, their caps of scarlet, green, or blue, adding bright flashes of color to the Autumn tints. More than a thousand of these students had enrolled for instruction in that Fall of 1895, so that the Pleicher Ring, a fine avenue with a park on one side of it and the main group of the scattered university buildings on the other, presented a veritable feast of color. Here is situated the Physical Institute, a modest, two-storey building with a roomy basement. It was the particular domain of Wilhelm Conrad Roentgen, who had his residence on the upper floor, and conducted his lectures and experiments in the remainder of the building. A tablet now proudly announces that here were discovered the Roentgen rays, and a handsome boulevard in the city perpetuates the name

WURZBURG INSTITUTE.

of their discoverer. But on this November day, as on countless days before, the Physical Institute was merely one of the many university buildings, and the unassuming man who quietly worked within but one of the four-score professors or teachers of the university staff. What, precisely, happened in that dim laboratory that made this building assume thereafter so unique an interest, and caused that comparatively obscure professor to be suddenly counted among the great? In what manner came the revelation that made the world open wide its eyes in wonder, and sent the correspondents of the great journals scurrying post haste to Wurzburg? Thirty-four years have elapsed since the discovery not only created the science of radiology, but marked the beginning of a new era of scientific thought, shaking the smug complacency of the Victorian age to its very depths. Thirty-four years of marvellous advancement, elaboration, and increasing complexity. It would be refreshing, therefore, to return for a moment to the fundamental simplicity of those earliest days, and hear the story of the event in the words of a man who had the priceless privilege of an interview with Roentgen in the first flush of his momentous revelation. His name was Dam, and he was the London correspondent of an American magazine.[1]

Among the mass of literature contemporary with the event, nothing has been found to excel the intimate and absorbing story, as presented by this man, and from his record, commencing with the moment of his arrival at the Physical Institute, some generous excerpts are quoted :

> "At the door I was met by an old serving man of the idolatrous order, whose pain was apparent when I asked for "Professor" Roentgen, and he gently corrected me with "Herr Doctor Roentgen". As it was evident, however, that we referred to the same person, he conducted me along a wide, bare hall, running the length of the building, with blackboards and charts on the walls. At the end he showed me into a small room on the right. This contained a large table-desk, and a

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[1] McClure's.

small table by the window, covered with photographs, while the walls held rows of shelves laden with laboratory and other records. An open door led into a somewhat larger room, perhaps twenty feet by fifteen, and I found myself gazing into a laboratory which was the scene of the discovery—a laboratory which, though in all ways modest, is destined to become enduringly historical."

"There was a wide table-shelf running along the farther side in front of two high windows which gave plenty of light. In the centre was a stove; on the left, a small cabinet whose shelves held the small objects the professor had been using. There was a table in the left-hand corner, and another small table—the one on which living bones were first photographed—was near the stove, and a Ruhmkorff coil was on the right."

"The lesson of the laboratory was eloquent. Compared, for instance, with the elaborate, expensive, and complete apparatus of, say, the University of London, or of any of the great American universities, it was bare and unassuming to a degree. It mutely said, that in the great march of science, it is the genius of man and not the perfection of appliances that breaks new ground in the great territory of the unknown. What possibilities of progress with unlimited and elaborate appliances, when the discoverer himself has done so much with so little!"

"Professor Roentgen entered hurriedly, something like an amiable gust of wind. He is a tall, slender, and loose-limbed man, whose whole appearance bespeaks enthusiasm and energy. He wore a dark blue, sack suit, and his dark hair stood straight up from his forehead, as if he were permanently electrified by his own enthusiasm. His voice is full and deep, he speaks rapidly, and, altogether, he seems clearly a man who, once upon the trail of a mystery which appealed to him, would pursue it with unremitting vigor. His eyes are kind, quick and penetrating; and there is no doubt that he much prefers gazing at a

> Crookes tube to beholding a visitor, visitors at present robbing him of much valued time. His greeting however, was cordial and hearty. In addition to his own language he speaks French well, and English scientifically, which is different from speaking it popularly. These three tongues being more or less within the equipment of his visitor, the conversation proceeded on an international or polyglot basis, so to speak, varying at necessity's demand."

Under good-natured protest, some very brief biographical information was first given, in answer to the interviewer's queries. He declined to look upon himself as being in any way out of the ordinary, and depreciated all eulogy of his achievement, laughing heartily at the idea of being famous. It was evident that the applause of the world embarrassed him.

> "Now, then," said he, smiling, and with some impatience when the preliminary questions at which he chafed were over, "you have come to see the invisible rays."
>
> "Is the invisible visible?"
>
> "Not to the eye, but its results are. Come in here."

Roentgen then led the way into his historic laboratory. To obviate the necessity of constantly keeping this room darkened an ingenious sort of light-proof sentry-box had been devised by the scientist. It was made of tin, and a circular window of aluminum had been soldered to one of its sides several feet from the ground. A few inches from the outer aspect of this window, a Crookes tube had been placed. Ensconced within this commodious box, and with his "barium paper" in his hand, the professor studied in solitary security the effects of those marvellous rays which he himself had christened with that brief, scientifically descriptive, and still popular designation "x". Nor does the retention of that designation by so many radiologists, in preference to "roentgen", necessarily indicate lack of appreciation of the scientist who revealed them. Familiar by long usage, eloquent in its simple brevity, the name selected by the master himself it would seem, will never be altogether displaced by the newer term.

Into the cabinet, then, the journalist is ushered, and the door closed behind him. He has been instructed how to use the little rudimentary fluorescent screen, and a demonstration follows which leaves him momentarily dumbfounded. Then he waxes eloquent in his prophecy of future development, even suggesting the possibility of a tube being devised, small enough for insertion into the human stomach, from which central point of vantage, visualization of surrounding regions might be made, a notion at which Roentgen grows merry. "When I have done this," he laughingly remarks, "I will tell you." In his enthusiasm the visitor is anxious to carry away a souvenir of the occasion, and intimates his desire to purchase the little table on which the first radiograph was made ; but the professor smilingly tells him it is not for sale. Next, he begs to be shown how that first—of how many millions?—picture was made, showing the bones of the living subject. Arranging a tube three or four inches from the under-side of the table top on which he places his hand, and with a plate wrapped in black paper resting steadily upon that hand, Roentgen obligingly demonstrates. Then :

> "You ought to have your portrait painted in that attitude," I suggested.
>
> "No, that is nonsense," said he smiling.
>
> "Or be photographed." This suggestion was made with a deeply hidden purpose.
>
> The rays from the Roentgen eyes instantly penetrated its deeply hidden purpose.
>
> "Oh, no," said he, "I can't let you make pictures of me. I am too busy."

Clearly the professor was entirely too modest to gratify the wishes of a curious world.

With the persistence of a true journalist, commendable in this instance at least, he lingers for more information. He has travelled far for his story and is reluctant to leave without a good one. Roentgen is therefore subjected to a questioning as to the precise circumstances of the discovery :

"Now, Professor," said I, "will you tell me the history of the discovery?"

"There is no history," said he, "I have been for a long time interested in the problem of the cathode rays from a vacuum tube, as studied by Hertz and Lenard. I had followed theirs, and other researches with great interest, and determined, as soon as I had time, to make some researches of my own. This time I found at the close of last October. I had been at work for some days when I discovered something new."

"What was the date?"

"The eighth of November."

"And what was the discovery?"

"I was working with a Crookes tube covered by a shield of black cardboard. A piece of barium platino-cyanide paper lay on the bench there. I had been passing a current through the tube, and I noticed a peculiar black line across the paper."

"What of it?"

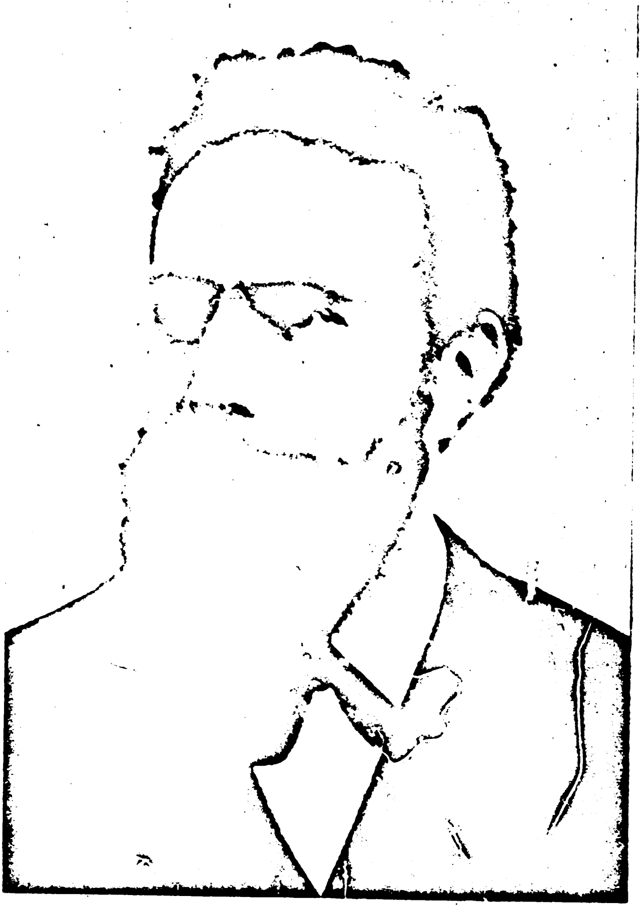
"The effect was one which could only be produced, in ordinary parlance, by the passing of light. No light could come from the tube, because the shield which covered it was impervious to any light known, even that of the electric arc."

"And what did you think?"

"I did not think, I investigated. I assumed that the effect must have come from the tube, since its character indicated that it could come from nowhere else. I tested it. In a few minutes there was no doubt about it. Rays were coming from the tube which had a luminescent effect upon the paper. I tried it at greater and greater distances, even at two metres. It seemed at first, a new kind of invisible light. It was clearly something new, something unrecorded."

"Is it light?"

"No."



WILHELM CONRAD ROENTGEN

From a photograph taken at Frankfort about the time of the discovery.

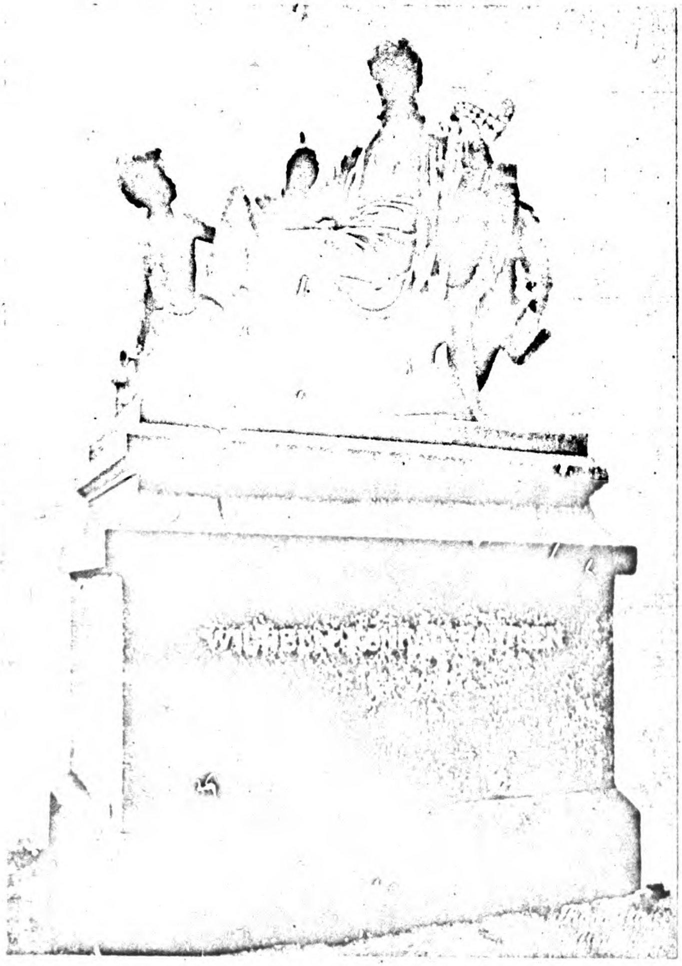
> "Is it electricity?"
> "Not in any known form."
> "What is it?"
> "I don't know."
>
> And the discoverer of the x-rays thus stated, as calmly, his ignorance of their essence, as has everybody else who has written on the phenomena so far."

At the conclusion of the interview, some prints of Roentgen's early radiographs were exhibited. They included a set of laboratory weights photographed within their box, a coil of fine wire on a wooden spool, some compasses in a case, and other simple objects. And carrying away vivid impressions of that unique hour with one of the most outstanding pioneers of science, the journalist took his leave of the old-world town of Wurzburg, wherein had just been born a radiance whose beams were destined to reveal a new world of wonder.

Attributed to Dr. T. S. Middleton of Chicago, who was a student at the Physical Institute in those fateful days of 1895, a story appeared in the course of an article by E. E. Burns, writing for the *Popular Science Monthly* of December, 1898. It concerned the now famous episode of the prophetic image of a key, which came to light on one of Roentgen's photographic plates prior to the discovery, and would seem to be the sole, though doubtless authentic source of that fascinating bit of history.

Roentgen, it appears, in a moment of pardonable abstraction, had placed a still active tube upon a book he had been reading in his laboratory, and left it there whilst attending to matters elsewhere. Serving as a book-mark, a flat key of ancient design was lying within the volume, and, either by accident, or possibly so placed for additional protection from daylight, a loaded plate-holder was beneath the book. With others, this plate-holder of mighty omen was used on a photographic expedition the same day, and development of the plate it contained, revealed the easily identified shadow of the key. Perplexed by this weird puzzle, he sought assistance in its solution from the youths of his class, with no success. Which is hardly surprising, since the student with the correct answer would have furnished thereby a clear title to fame. Theory having failed to help him, Roentgen attempted to solve the mystery in a practical way. Remembering the precise positions of the tube, the book with its novel marker, and the holder, he carefully re-set the stage, and the actors in the little drama were made to perform their parts again. What his emotions were on once more beholding the outline of the key on a plate that, this time, had been exposed with such deliberation, can be imagined but faintly. It is sufficient to know that with this ghostly key a door was unlocked leading to a discovery that proved to be one of the most outstanding in the history of science; for the intensive investigations which followed had their exceeding great reward in the revelation of the eighth day of November, 1895.

On the twenty-eighth of the following December Roentgen read a paper before the Physico-medical Society at Wurzburg. It was modestly entitled "Concerning A New Ray". Whatever his inner emotions might have been he presented it with the same subdued, matter-of-fact delivery, as if his message concerned merely a new style of test-tube, or a new method in conducting some minor investigation. At the conclusion of his address, the venerable anatomist Von Kolliker was invited by Roentgen to place his hand behind the screen. "Never," says one who was present, "will the thrill of that first glimpse of the living skeleton be forgotten." Both the lecture and the demonstration that confirmed its amazing import, created a profound impression, and prolonged applause greeted the discoverer. Roentgen entered that historic meeting, an average German professor, with little more than a local reputation; he left it to take an honored place among the brilliant names in the boundless realm of Science.



ROENTGEN MONUMENT, BERLIN

BIOGRAPHICAL

1895 — 1923

ROENTGEN became famous over-night. All around the world, echoed and re-echoed, the applause that greeted him at the conclusion of his history-making paper. Nor could his sincere habitual modesty, nor his love of the quiet, unobtrusive activities of university life, hide this simple, lovable man, from the dazzling glare of the publicity he disdained. Not that he lacked appreciation of the honors that were so lavishly thrust upon him; he accepted them graciously. But his nature found its highest happiness in the quiet life of his home, the friendship of kindred souls, and the absorbing work of the laboratory. Even in the latter field, his best results were obtained, when he was absolutely alone. Enthroned securely at the very peak of renown, this elevation seems to have been regarded as the penalty, rather than the reward of his labors.

Among the first to recognize the rise of this new and luminous star in the firmament of science, was William II, Emperor of Germany and King of Prussia. Roentgen was summoned to the royal palace at Potsdam, dined in state, spent the evening in conversation with his Imperial host, demonstrated his discovery, and left at midnight, decorated with the Crown Order of the Second Class. Ludwig, prince-regent of Bavaria, bestowed upon him the Knight's Cross of one of the Bavarian orders, a decoration which carried with it the privilege of prefixing his name with the coveted particle "Von". A government decree made him "Excellency". Wurzburg conferred upon him the honorary degree of Doctor of Medicine, and re-named a boulevard of the city in his honor. His portrait was placed in the Physical Institute, a tablet unveiled, and his laboratory has become a Roentgen museum. He had the rare distinction of having a striking monument erected to him, during his life-time. It stands at the approach to the Potsdam bridge in Berlin, close to similar memorials to some of the greatest names of the Fatherland. In 1901 he was awarded the first of the Nobel prizes for Physics, "in recognition of the exceptional services rendered by him in the discovery of the special rays which have been named after him." This award was generously donated by Roentgen to a society in his native land, established for the encouragement of scientific research. Columbia University gave him the Barnard medal for the most outstanding discovery over a period of years; London honored him in similar ways. Both the Bavarian and the Prussian Academies of Science elected him to membership. Laurels, indeed, flocked to him from the ends of the earth.

Yet beneath this deluge of acclaim, Roentgen remained unspoiled. Fame could not intoxicate him; eulogy brought but a smile. He continued to live his accustomed simple life in Wurzburg; remained faithful to his students and old associations, declining the flattering offers from Berlin and elsewhere that sought to lure him away. Never was he known to have displayed a thirst for money, but, on the contrary, persistently refused to profit financially from the results of his discovery. He would not limit its progress or usefulness by any patent or monopoly in his own favor, or in that of anyone else. His happiness over the golden revelation was expressed by placing the new-found treasure without restriction, at the disposal of all—a thank-offering. For, as he with heartfelt sincerity expresses it, the German professor enjoys so rich a support in his work through state aid in the matter of good laboratories, in the free disposal of his time in his highly favored position, that he rejoices in any opportunity to show his gratitude.

An incident related by a former student under Roentgen in his Wurzburg days, illustrates in an eloquent way, the very modest ideas of the scientist in regard to financial matters. At work in one of the laboratories of the Physical Institute this student noticed on one of the benches, a scrap of paper covered with Roentgen's script. It proved to be the draft of a letter addressed to some manufacturer of scientific equipment. To this man he had written, that, unless the tubes he required for experimental work could be produced for the equivalent of five dollars each, he would have to build them himself.

Twelve very happy years of life at Wurzburg came to an end in 1900, when, in compliance with the urgent desire of the government, he accepted the call of Munich to become director of the Academy of Technical Physics at that university. In this stately capital of Bavaria, with its magnificent squares and gardens, its imposing public buildings, and famous library, Roentgen spent the remaining years of his life.

Practically unlimited freedom was given to him in the arrangement of his work at Munich. He had left the rapidly expanding application of the x-rays, in their various fields, to the development their own merits had stimulated, and resignedly turned again to his own unobtrusive and seemingly thankless realm of activity. He was not a brilliant lecturer, and was invariably nervous, particularly at the beginning of his address. His special lecture, given annually for beginners, more especially for those commencing the medical course, while carefully prepared, was not popular, because his listeners deemed it too difficult for them to assimilate. Teaching in his own laboratory he was much happier, for in that congenial atmosphere he felt natural and at ease.

Although frequently invited, Roentgen rarely attended learned associations or conferences, because of a reluctance to discuss scientific matters about which he had not yet formed clear and definite ideas. In his criticisms, it was his habit to label as "unlaid eggs", any premature communications on the results of research.

Recreation at this time was found in frequent trips to the mountains that always fascinated him. In hunting also, he found keen delight, and that he might easily indulge the sport the governors of the nearby province of Weilheim bestowed special privileges upon him, making him an "Honor" citizen.

Both he and his wife—they had no children—were members of the Protestant church. Among intimate friends were Professor Georgii, who created the life-like bust of Roentgen, unveiled in the Lichthof of the University of Munich, on the 27th of July, 1928, a photograph of which, is reproduced herein; Professor A. Sommerfeld, still on the university staff at Munich, in whose career Roentgen was keenly interested, and Professor and Mrs. Boveri. A professor in her own right, the widow of Doctor Boveri now teaches zoology in the Women's College at New Haven.

Despite the phenomenal measure of success which came to him, a wistful note of sadness crept into the later years of his life, for even the gentle soul of Roentgen did not escape calumny. Envious tongues circulated a baseless story imputing the discovery of the x-ray to the work of an assistant. This slander, as it well might, seems to have embittered him, forcing him more and more into a closer silence and solitude. With almost equal cruelty and in the face of incontrovertible facts, a fellow-countryman, in an article on German intellectualism, published a false and contemptible statement that Roentgen was mercenary, "selling his discovery to the world for what it would fetch."

Great sadness came upon him too, with the outbreak of the war, for the early successes of the Central Powers could not deceive him as to that inevitable outcome he foresaw with startling clarity. Withal, he was a loyal German, trusting the wisdom of his country's rulers in simple faith. When, in October, 1914, the notorious declaration of the ninety-three intellectuals was given to the world, he was one of the signers. Nor did he, as so many of them did, repudiate this document at the close of the war, explaining that they had signed it hurriedly, or without grasping its import.

As the years wore on, he became a sad and lonely old man. In the excitement of the war little sentiment could be spared from that vast wave of enthusiasm and sympathy that went out to the fighting-men and their leaders. Even the seventieth birthday anniversary of the man whose genius had done so much to ameliorate the lot of the battle-stricken, was almost forgotten, Sommerfeld wistfully notes. A new and strange generation was growing up around him, amid the dark passions of a colossal world conflict, and with loved friends for the most part dead, little of the brighter side of life remained for him. A final glimpse of him at the university is provided in the description given by a witness of a meeting between Roentgen and Hindenburg, when the "two men who have done the most for Germany", shook hands. In 1919 he resigned his chair and retired to a village suburb of Munich. Shortly afterwards a bitter blow was received when his wife, with whom he had lived so happily, passed away after a lingering illness, throughout which he had acted as a faithful, self-sacrificing nurse. Tormented by the infirmities of age, he survived her for three years, the weary days being brightened now and then by dreams of the lofty peaks he was never to see again. He died on the 10th of February, 1923, at the age of seventy-eight, the immediate cause of death being ileus induced by a malignant growth in the lower bowel, of which he was unaware. His death occurred in the home of the widow of Professor Boveri. On the 13th, his body was cremated at the Ostfriedhof cemetery, Munich, and his ashes repose in the cemetery of Geissen, in which little town he had spent some of the most peaceful years of his life.

Happily a published report that Roentgen died in poverty, has been contradicted from an authoritative source. While far from rich, his circumstances were such that the brief years of his retirement were spent amid all the reasonable comforts of life.

So he sleeps, careless alike of eulogy or vituperation. He blessed the world with an imperishable boon, and his name liveth for evermore. Monuments of stone and bronze commemorate his worth, but the greatest of all memorials are the countless, thankful hearts, whose sufferings have been made lighter by the ministrations his discovery made possible.

ROENTGEN

Without hesitation Roentgen may be classed as one of the greatest and noblest figures of his generation. Of no profound scholarship, in the conventional sense of that term, he belonged to that type of man, says Sommerfeld "who, without Latin and Greek, become great". Even so, did Shakespeare. "Like Faraday", says Garrison, "he was no mathematician, but a wonderful stimulator of capable youth ; a midwife of mind."

His genius—nor is there any exaggeration in the term—found its outlet in the empirical, rather than the theoretical realm of science, and his dogged patience, excelling accuracy and precision in practical research, have made him a classicist in this field. Proof of this is furnished in the fact that within the compass of his three brief communications regarding the physical properties of the rays he revealed, there is a comprehensiveness which approaches finality. Laue's discovery of their wave nature, fifteen years later, was the first important addition to the knowledge of the physical side of the phenomenon.

Completely overshadowed by that adjective-exhausting revelation of the x-ray, his achievements in other branches of physics have been almost forgotten. Yet he published many scholarly treatises on capillarity, electro-magnetics, and many other subjects, embracing even that seemingly foggy zone of the theory of relativity. These contributions, says Wein, his successor to the chair at Munich, would have given him a notable standing among the great physicists, apart altogether from the immortal discovery which made him a Columbus among the pioneers of science.

A mighty man of achievement, a modest and lovable character, he has richly earned the reverence and admiration of all mankind ; while to the professional radiologist whose science he founded, the wonderful patience and thoroughness of his methods of working stand revealed for all time, a challenge and an inspiration.

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